

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY



(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 14 SEP 2005

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Applicant's or agent's file reference 2003P05858WO	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/US2004/018026	International filing date (day/month/year) 04.06.2004	Priority date (day/month/year) 06.06.2003
International Patent Classification (IPC) or national classification and IPC B25B29/02, B23P11/02		
Applicant SIEMENS WESTINGHOUSE POWER CORPORATION et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 12 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand 05.04.2005	Date of completion of this report 13.09.2005	
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer:  Kühn, T  Telephone No. +49 89 2399-7883 	

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/US2004/018026

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
- ☐ publication of the international application (under Rule 12.4)
- ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

### Description, Pages

1, 2, 5-19

as originally filed

3, 4, 4a

received on 19.04.2005 with letter of 30.03.2005

### Claims, Numbers

1-10

received on 19.04.2005 with letter of 30.03.2005

### Drawings, Sheets

1/6-6/6

received on 19.04.2005 with letter of 30.03.2005

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☒ the claims, Nos. 1-7
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (*specify*):
- ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/US2004/018026

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	14
	No: Claims	1-13,15-18
Inventive step (IS)	Yes: Claims	
	No: Claims	1-18
Industrial applicability (IA)	Yes: Claims	1-18
	No: Claims	

2. Citations and explanations (Rule 70.7):  
see separate sheet

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/US2004/018026

**Re Item I**

**Basis of the opinion**

Unfortunately, the applicant did not identify the differences between the respective replaced sheets and the replacement sheets (cf. Rule 66.8(a) PCT) as well as the basis for the amendments.

At least the omission of the feature "a tensioner responsive to a pressure to apply a force to tension the shank member" in current claim 1 goes beyond the disclosure in the international application as filed (cf. Art. 19(2) PCT), since it is an essential feature which is indispensable for the function of the invention.

Therefore, the reasoned statement is based on claims 1-18 as originally filed (cf. Rule 70.2(c) PCT).

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

- 1 The following documents are referred to in this communication:

D1 : PATENT ABSTRACTS OF JAPAN vol. 0080, no. 50 (M-281), 7  
March 1984 (1984-03-07) & JP 58 203214 A (MITSUBISHI JUKOGYO KK), 26  
November 1983 (1983-11-26)

D2: FR 902 682 A (SKF SVENSKA KULLAGERFAB AB) 10 September 1945  
(1945-09-10)

- 2 INDEPENDENT CLAIMS 1,6,9,15

- 2.1 With respect to independent claim 1

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.

Document D1 discloses (the references in parenthesis applying to this document):  
A tensioning apparatus comprising:

a shank member (12);  
an annular member (11) comprising an opening sized to receive the shank member  
with an interference fit (cf. fig. 2);  
a fluid passageway (13,14,24) for delivering a pressure between the shank member  
and the annular member for expanding the opening to relax the interference fit;  
a tensioner (29) responsive to a pressure (P) to apply a force to tension the shank  
member (cf. fig. 4)

wherein a first pressure is required in the fluid passageway to relax the interference fit when the shank member is relaxed, and a second pressure lower than the first pressure is required in the fluid passageway to relax the interference fit when the shank member is tensioned; and wherein the tensioner (29) is selected to provide a desired tensioning force to the shank member at the second pressure (in order to push the annular member along the fitting surface of the shank) so that a single pressure source may be used to provide pressure to the fluid passageway and to the tensioner to achieve a desired preload in the shank member (P, cf. fig. 4).

**2.2 With respect to independent claims 6 and 9**

Since the subject-matter of each of independent claims 6 and 9 corresponds to the subject-matter of claim 1 the same reasoning as given for claim 1 applies likewise for claims 6 and 9.

Therefore claims 6 and 9 also do not meet the requirements of the PCT in respect of novelty and/or inventive step (Article 33(2) and (3) PCT).

**2.3 With respect to independent claim 15**

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 15 is not new in the sense of Article 33(2) PCT.

Document **D1** clearly and unambiguously discloses all the method steps as comprised in independent method claim 15.

**4 DEPENDENT CLAIMS 2-5, 7, 8, 10-14, 16-18**

In view of the documents **D1** and **D2**, dependent claims 2-5, 7, 8, 10-14, 16-18 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step (Article 33(2) and (3) PCT).



19. 04. 2005

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(110)

FIG. 6 is a cross-sectional view of a low-profile tensioner bearing upon an annular member to perform a tensioning operation while the annular member is expanded to relax its interference fit with a shank member.

FIG. 7 is a cross-sectional view of an annular member having a plurality of grooves along its bore and having seals at opposed ends of the bore.

FIG. 8 is a sectional view of a tensioning apparatus being powered by a single source of high-pressure fluid selectively fluidly connected to the annular member and/or to the tensioner through valves.

FIG. 9 illustrates a method of tensioning a shank using the system of FIG. 8.

FIG. 10 is a schematic illustration of a tensioning system using an oil/water converter.

FIG. 11 is a plan view of a shank and annular member illustrating the locations of fluid passageways.

## DETAILED DESCRIPTION OF THE INVENTION

The term "shank member" when used herein is meant to include elongated tension members such as bolts, studs, rods and the like whether or not they include an integral head or threads. A shank member has opposed ends, with each end having a mechanism for applying respectively opposed forces across a joint to produce a tension load in the shank. Such mechanisms may include an integral head or threads for threaded connection with a threaded nut. The term "nut" when used herein is meant to include an annular member defining an opening for receiving a shank member. The term nut is generally used in the art to denote an annular member having threads formed on its inside surface for threaded engagement with a shank member. However, in the present application, the term nut may also be used to denote an annular member having no threads on its inside surface, but rather being engaged with a shank member by an interference fit.

FIG. 1 illustrates a tensioning apparatus 10 including a shank member 12 and an annular member 14. The annular member 14 has an unthreaded inside surface 16 defining an opening 18 for receiving the shank member 12, with the opening 18 being sized to provide an interference fit connection between the shank member 12 and an unthreaded critical diameter portion 36 of the annular member 14. The shank member

12 functions as a stud and the annular member 14 functions as a nut because it grips the stud to transfer a tensile force across a flanged joint (not shown). However, the shank member 12 and annular member 14 lack the mating threads that are normally found in a typical prior art stud/nut arrangement. Rather, the interference fit between the shank member 12 and the annular member 14 provides sufficient friction for resisting relative motion there between when the shank member 12 is placed into tension between the annular member 14 and a threaded nut 30 on an opposed side of the joint.

In order to facilitate a flange tensioning process using the tensioning apparatus 10, a means is provided for conveying fluid pressure into the opening 18 to selectively expand the annular member 14 to relax the interference fit, thus selectively allowing relative motion between the annular member 14 and the shank member 12 while the shank member 12 is being pre-tensioned. One such means is illustrated in FIG. 1 as a fluid passageway 20 formed through the annular member 14 from an outside surface 22 of the annular member 14 to the inside surface 16. As can be seen most clearly in the expanded view provided in FIG. 2, fluid passageway 20 includes a hole 24 formed from the outside surface 22 to the inside surface 16 and a groove 26 formed along the inside surface 16 to be in fluid communication with the hole 24. The hole 24 is connected to a supply of pressurized fluid. Groove 26 extends 360° around the circumference of opening 18 to apply the fluid pressure evenly around the circumference of the inner surface 16. One or a plurality of interconnected grooves 26 may be formed along the inside surface 16 to direct the fluid pressure across an appropriate area of the inside surface 16 so that the annular member 14 may be selectively expanded an amount sufficient to allow movement along shank member 12 without creating unacceptably high stress concentrations within the annular member 14 or shank member 12. In one embodiment, groove 26 may be formed in a single plane lying generally perpendicular to the axis of the shank member 12. In another embodiment, the groove may have a spiral shape deviating somewhat above and below such a plane at various points about the circumference of the inside surface 16. Alternatively, as illustrated in FIG. 11, two spaced apart circumferential grooves 260 may be joined by a helical shaped groove 262 formed on the inside surface 264 of the annular member 266, with the fluid pressure being supplied either through a hole formed in the annular member or through

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a longitudinal hole 268 in fluid communication with a radial hole 270 and mating outside surface groove 272 formed on the shank member 274.



## CLAIMS

1. A tensioning apparatus (200) comprising:
  - a shank member (236) comprising a length along a longitudinal axis and an outside surface parallel to the longitudinal axis along a mating portion (36);
  - an annular member (206) comprising an opening (18) defined by an inside surface (16) parallel to the longitudinal axis and sized to receive the shank member mating portion with an interference fit for resisting relative motion under the influence of a tensioning force being transferred there between; and
  - a fluid passageway (20) for selectively delivering a fluid pressure between the shank member outside surface and the annular member inside surface to generate a radial force with no axial force component to expand the opening for relaxing the interference fit for selectively allowing the relative motion between the annular member and the shank member along the mating portion.
2. The tensioning apparatus of claim 1, further comprising a tensioner (210) responsive to a fluid pressure for applying the tensioning force into the shank member by pulling on the shank member while pushing on the annular member.
3. The tensioning apparatus of claim 2, wherein the tensioner further comprises:
  - a piston (108) disposed within a cylinder (110) to define a pressure chamber (112);
  - a first of the piston and cylinder connected to the shank member for applying the tensioning force to tension the shank member and a second of the piston and cylinder connected to the annular member for applying a reaction force through the annular member.
4. The tensioning apparatus of claim 2, further comprising:

a single pressure source (214) providing the fluid pressure to the fluid passageway for relaxing the interference fit and to the tensioner for applying the tensioning force; and

the tensioner being selected to provide a desired tensioning force to the shank member at a fluid pressure value that is necessary to relax the interference fit when the shank member is carrying the desired tensioning force.

5. The tensioning apparatus of claim 2, further comprising:  
a pressure source (214) in fluid communication with the tensioner for applying the tensioning force; and  
the pressure source in fluid communication with the fluid passageway through a pressure converter (202) for relaxing the interference fit.

6. A tensioning apparatus claim 5, further comprising:  
oil (208) used as a working fluid in the pressure source and being provided to the tensioner and to a first side of the pressure converter; and  
water (204) used as a working fluid on a second side of the pressure converter and being provided to the fluid passageway.

7. The tensioning apparatus of claim 1, the fluid passageway further comprising:  
a hole (24) formed from an outside surface of the annular member to the opening; and  
a groove (26) formed along the inside surface of the annular member and intersecting the hole.

8. The tensioning apparatus of claim 1, wherein the tensioner further comprising:  
an axial passageway (86) formed in the shank member; and  
a circumferential groove (88) formed on the outside surface of the shank member in fluid communication with the axial passageway via a radial hole (87).

9. A tensioning apparatus of claim 1, the fluid passageway further comprising:

an axial passageway (268) formed in the shank member;  
a circumferential groove (272) formed on the outside surface of the shank member in fluid communication with the axial passageway through a radial hole (270);  
and

a pair of spaced apart circumferential grooves (260) joined by a helical groove (262) formed on the inside surface (264) of the annular member (266).

10. The tensioning apparatus of claim 1, further comprising the annular member selected to have a coefficient of thermal expansion that is lower than a coefficient of thermal expansion of the shank member.

REPLACEMENT SHEET

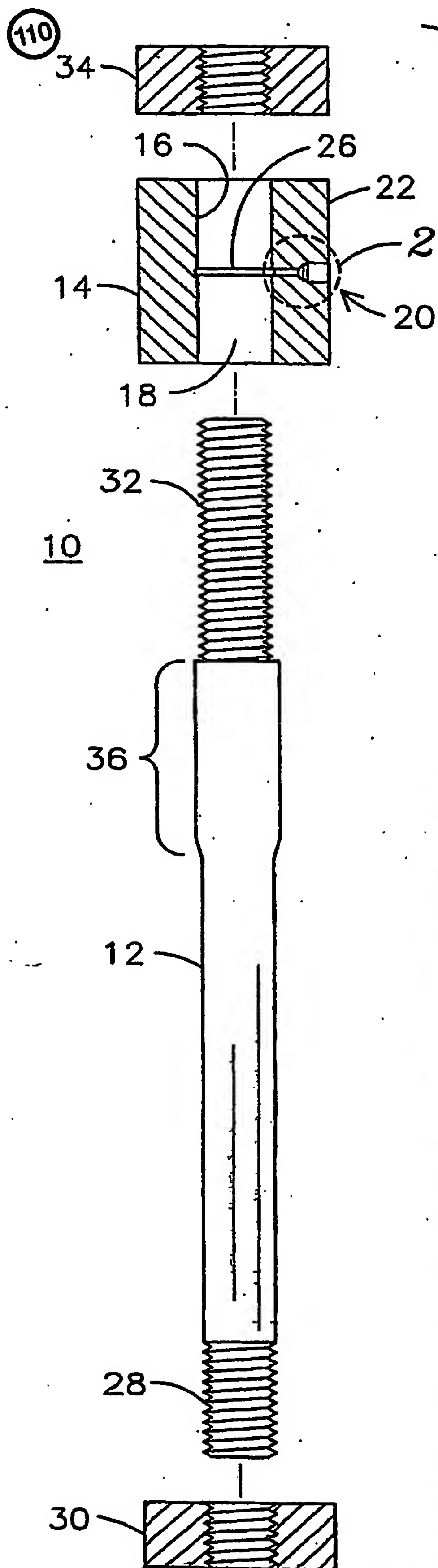


FIG. 1

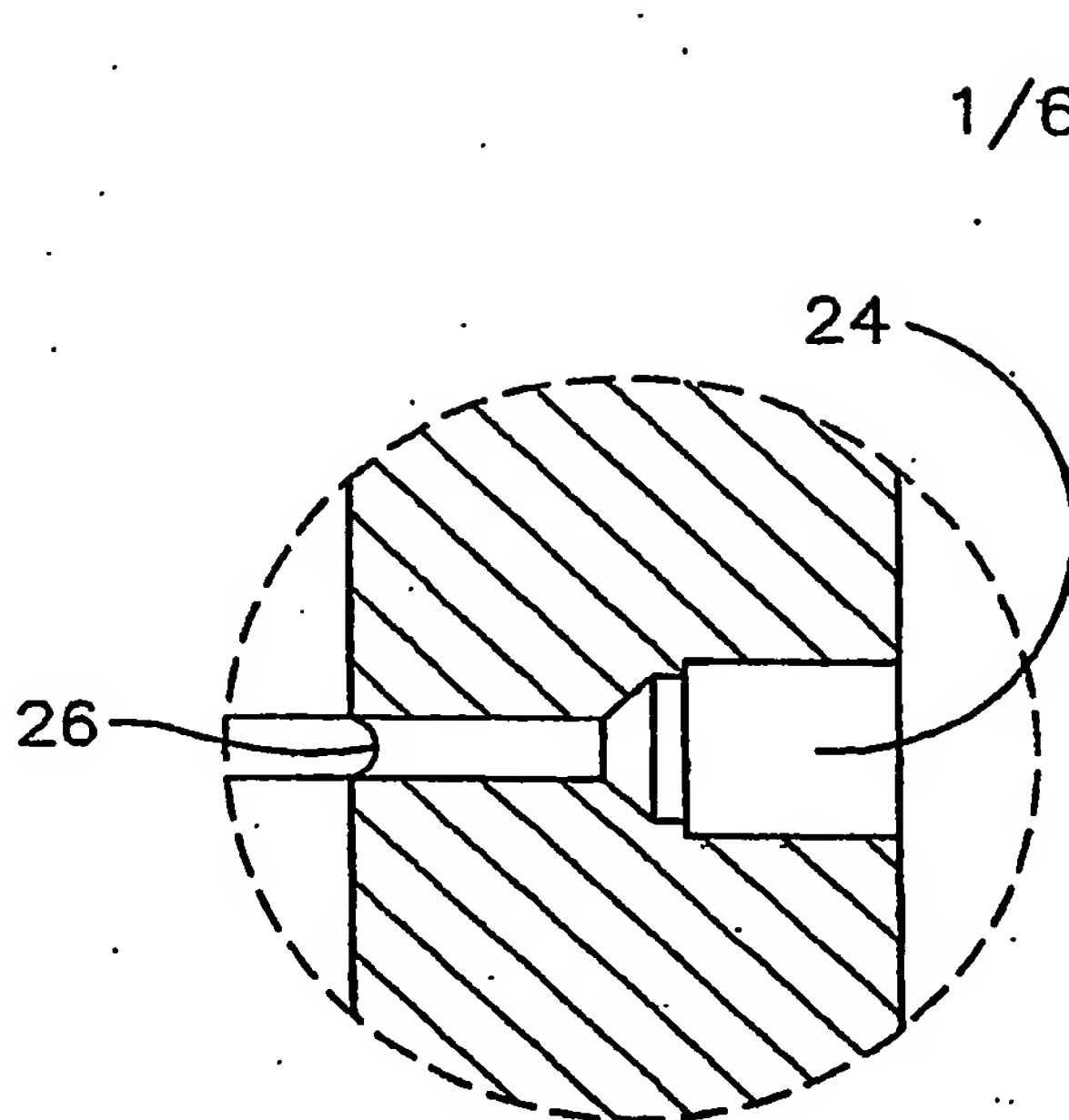


FIG. 2

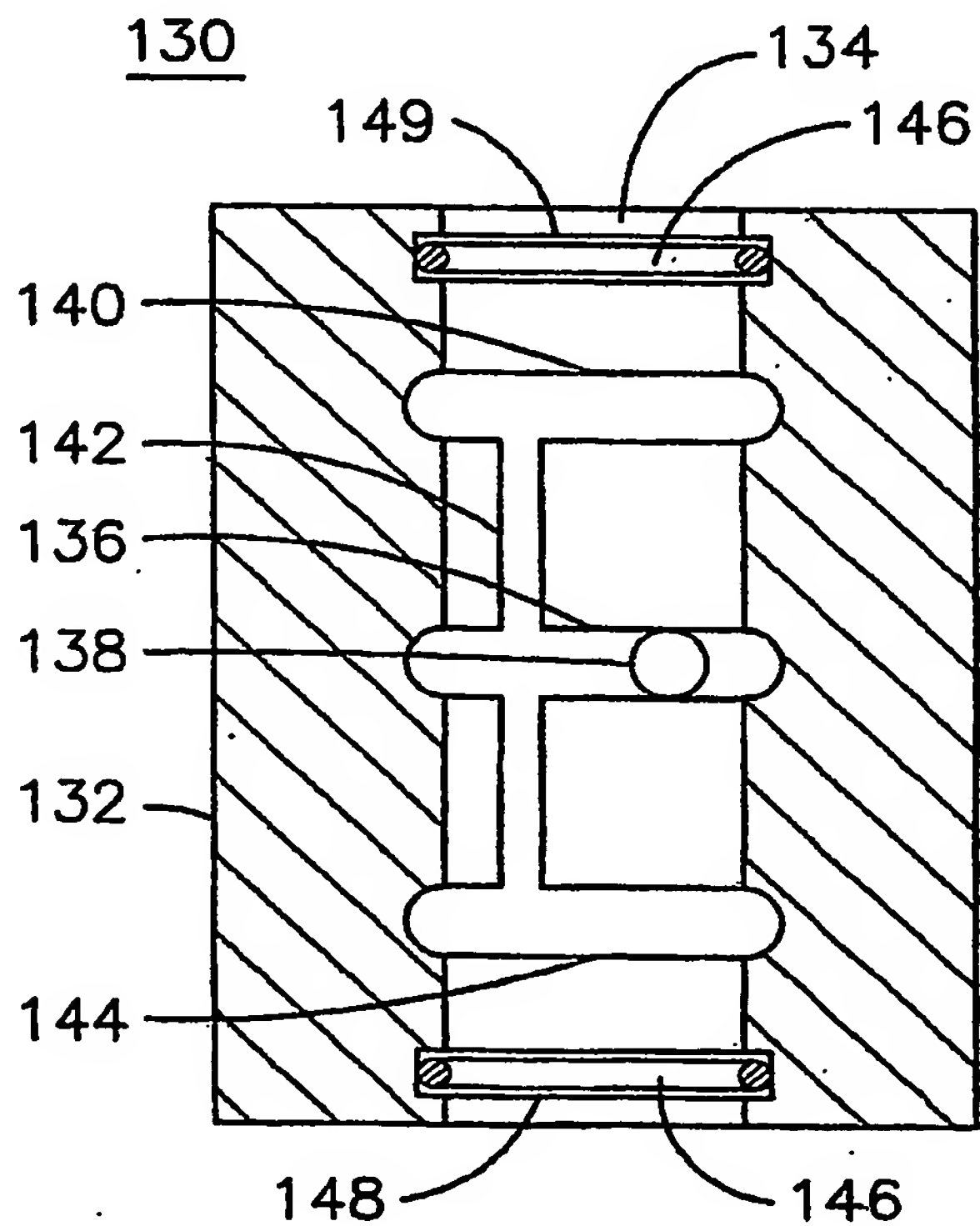


FIG. 7

REPLACEMENT SHEET

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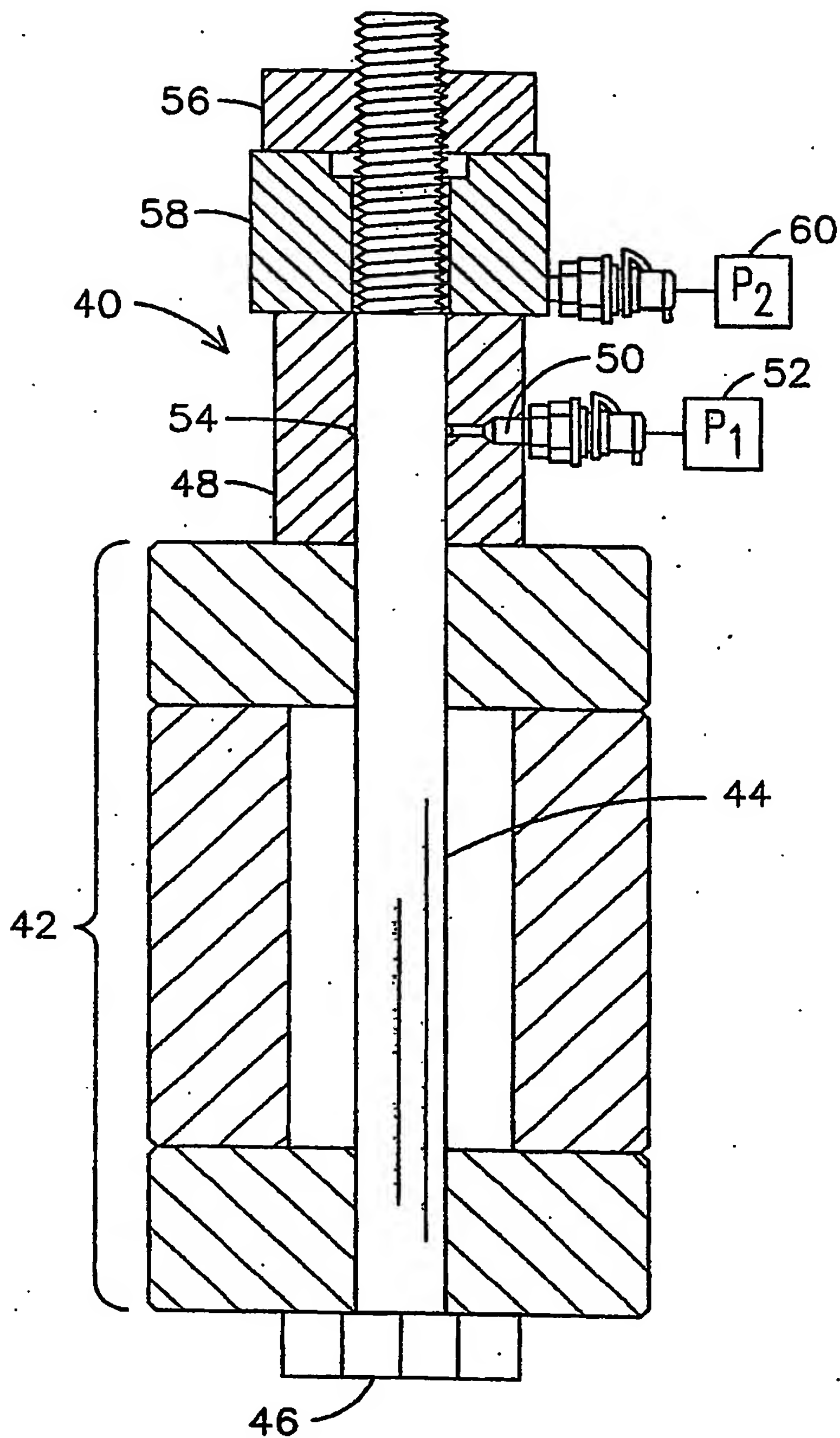


FIG. 3

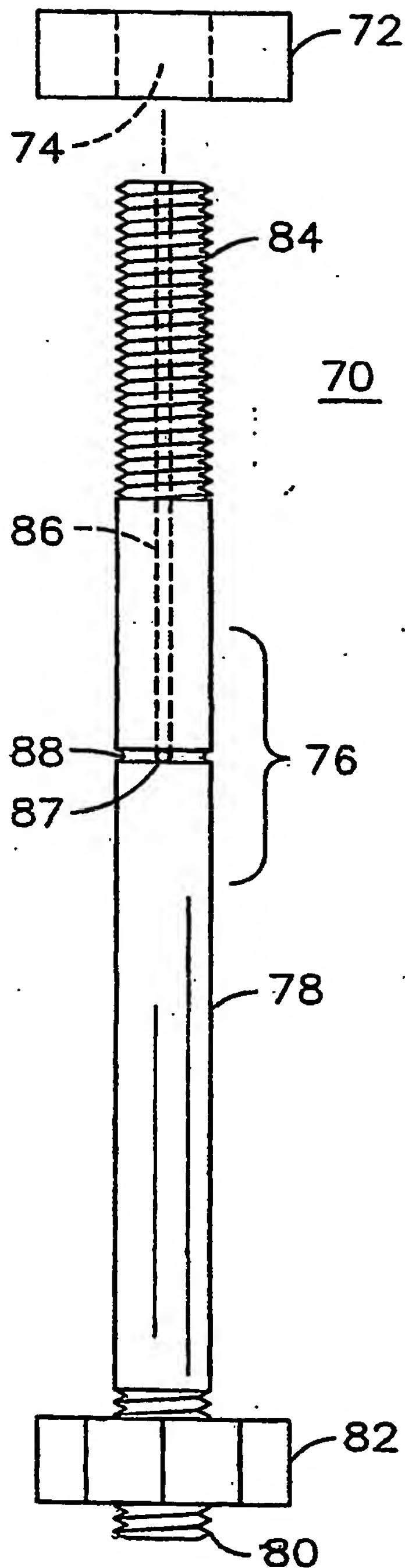


FIG. 4

REPLACEMENT SHEET

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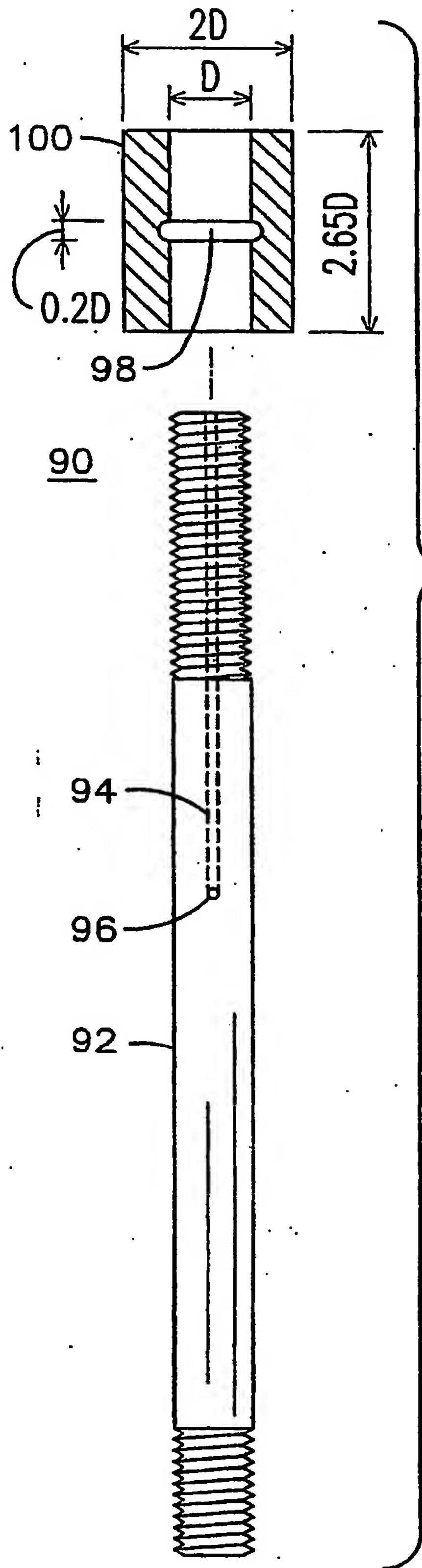


FIG. 5

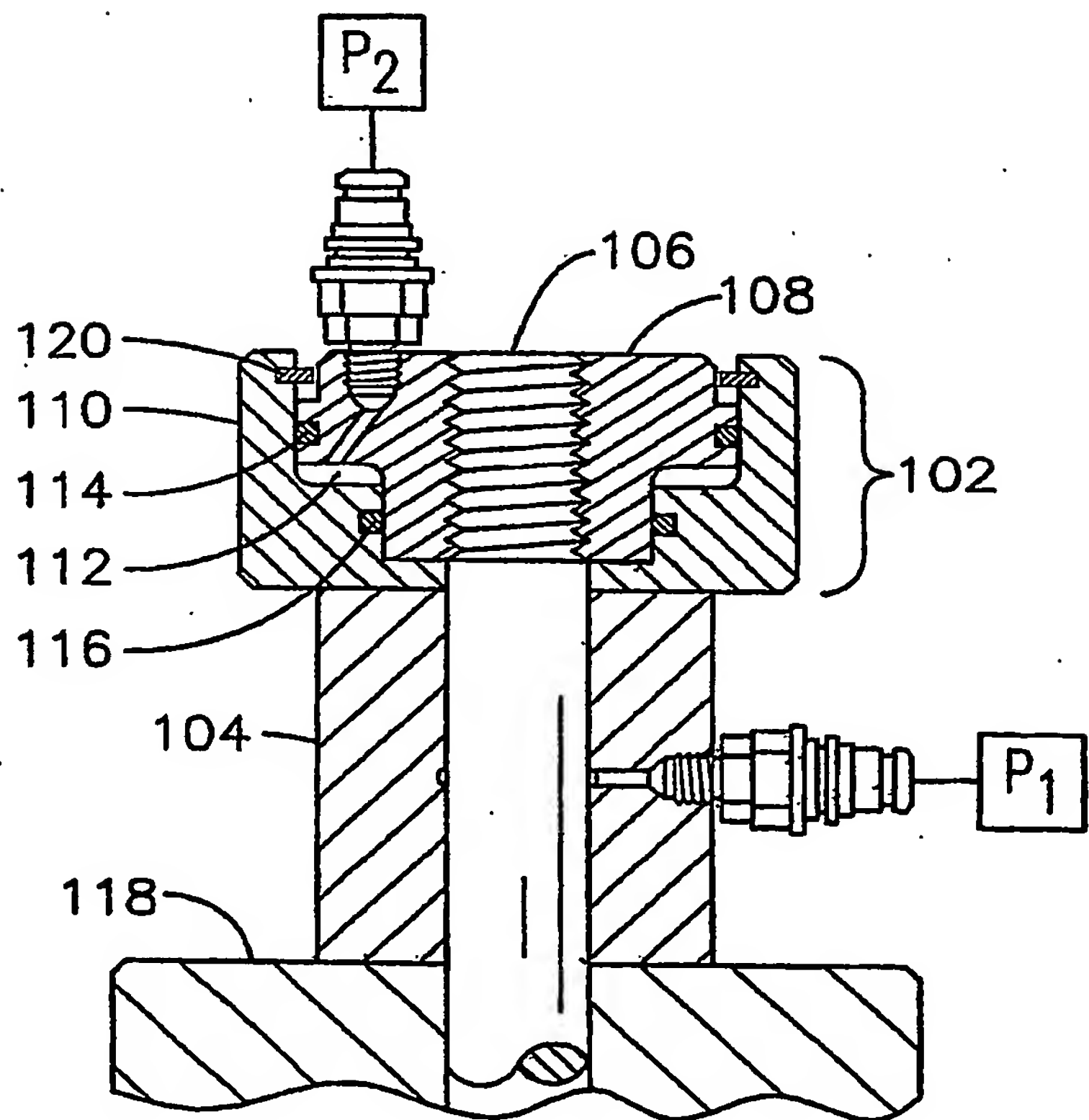


FIG. 6



REPLACEMENT SHEET

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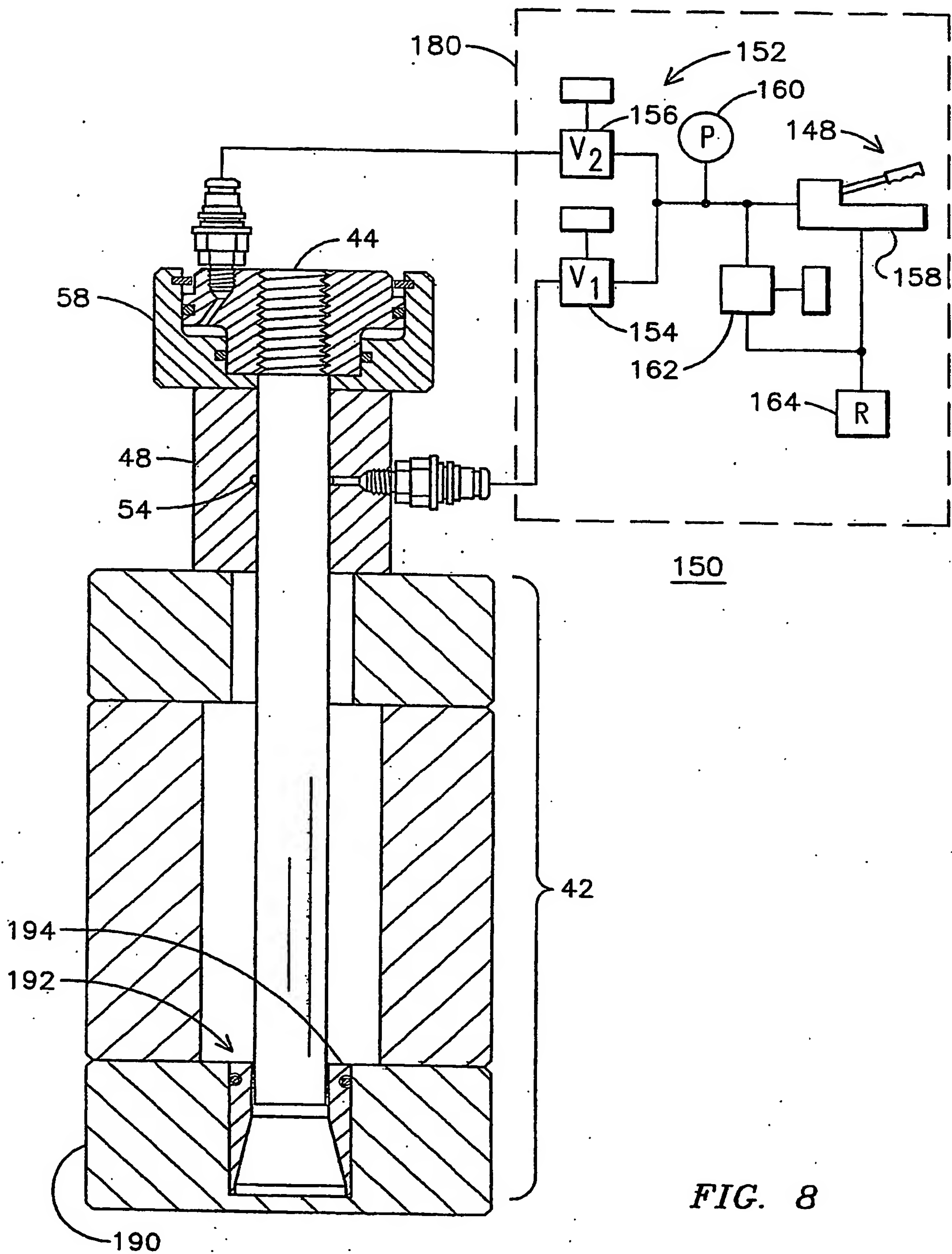
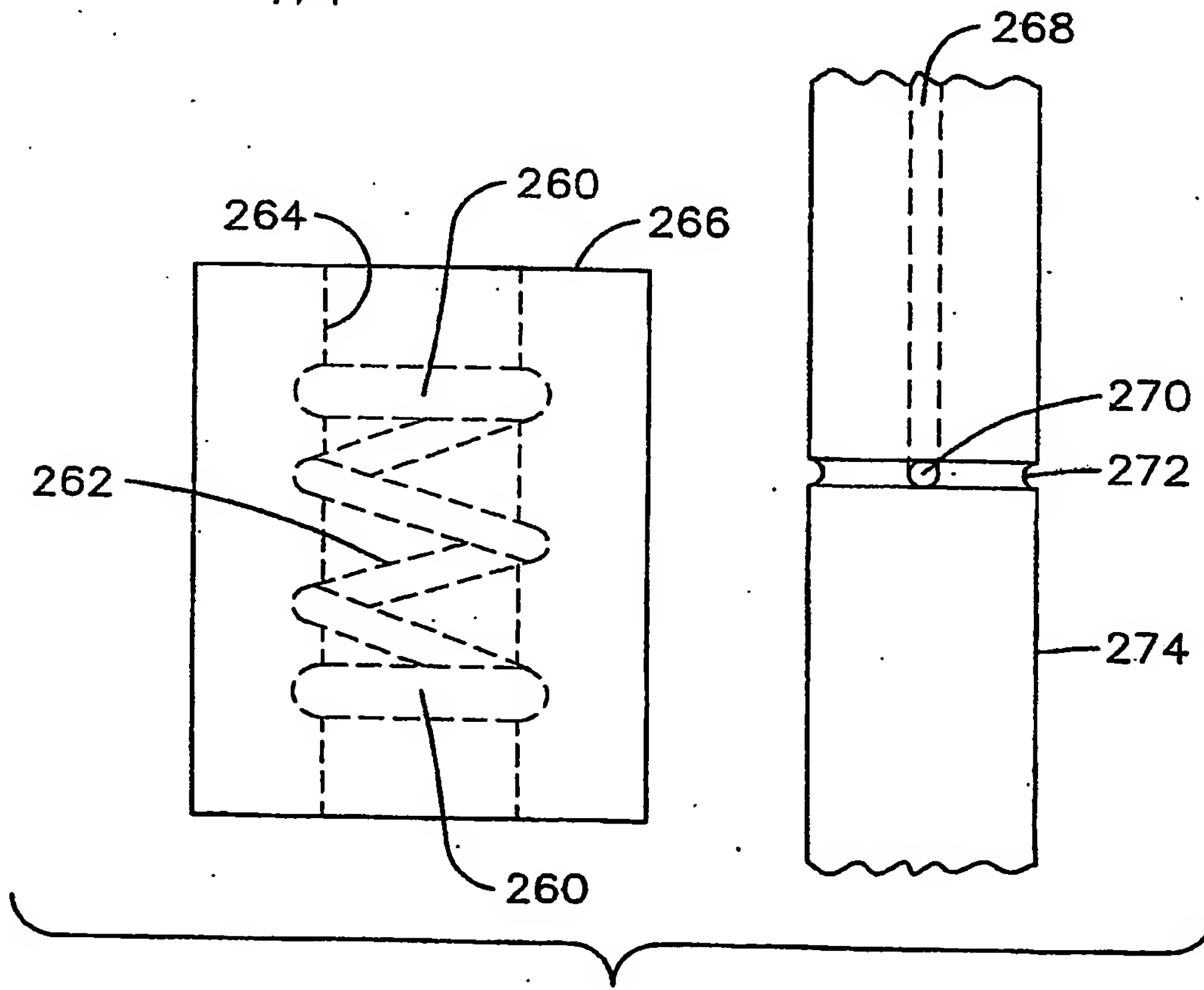
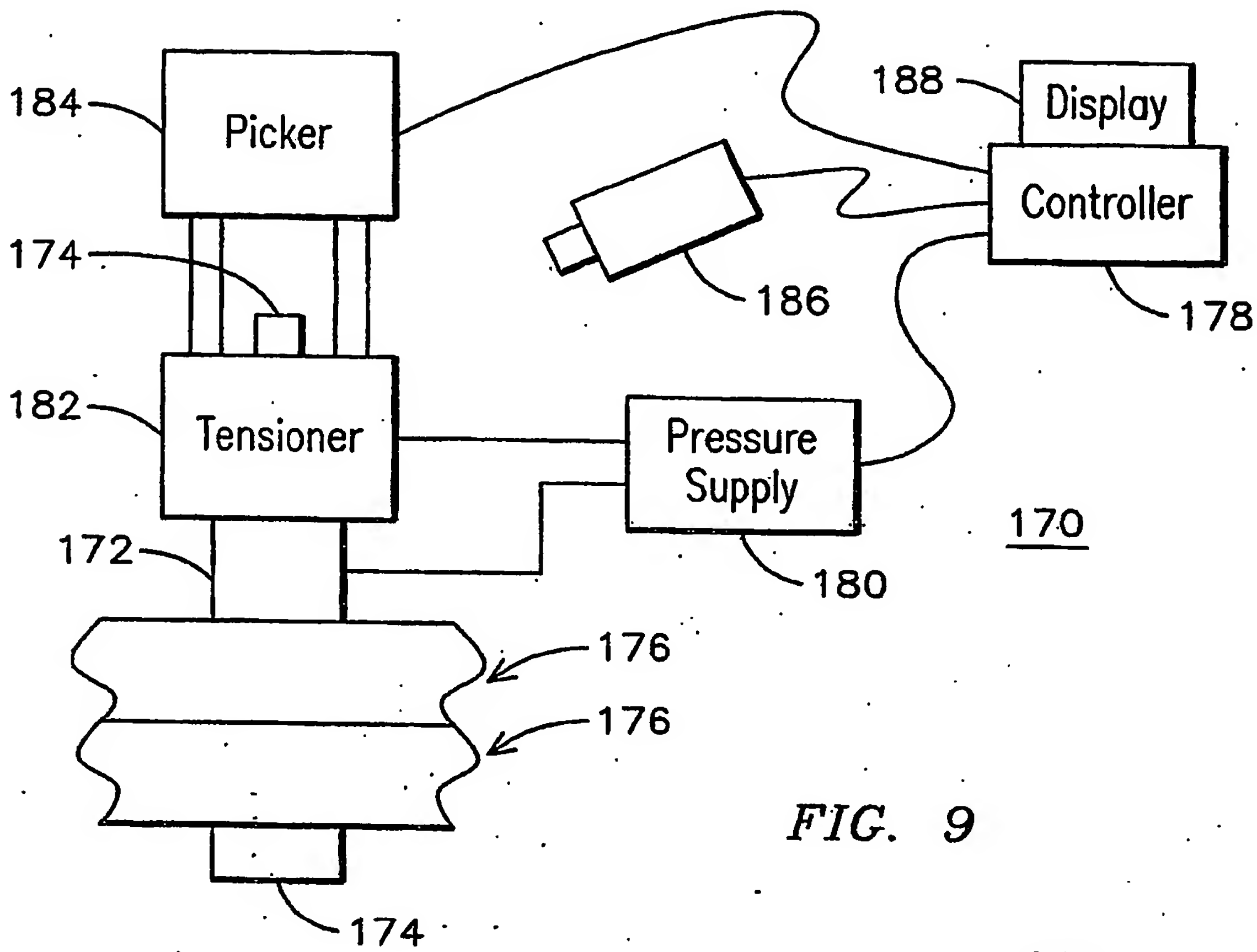


FIG. 8

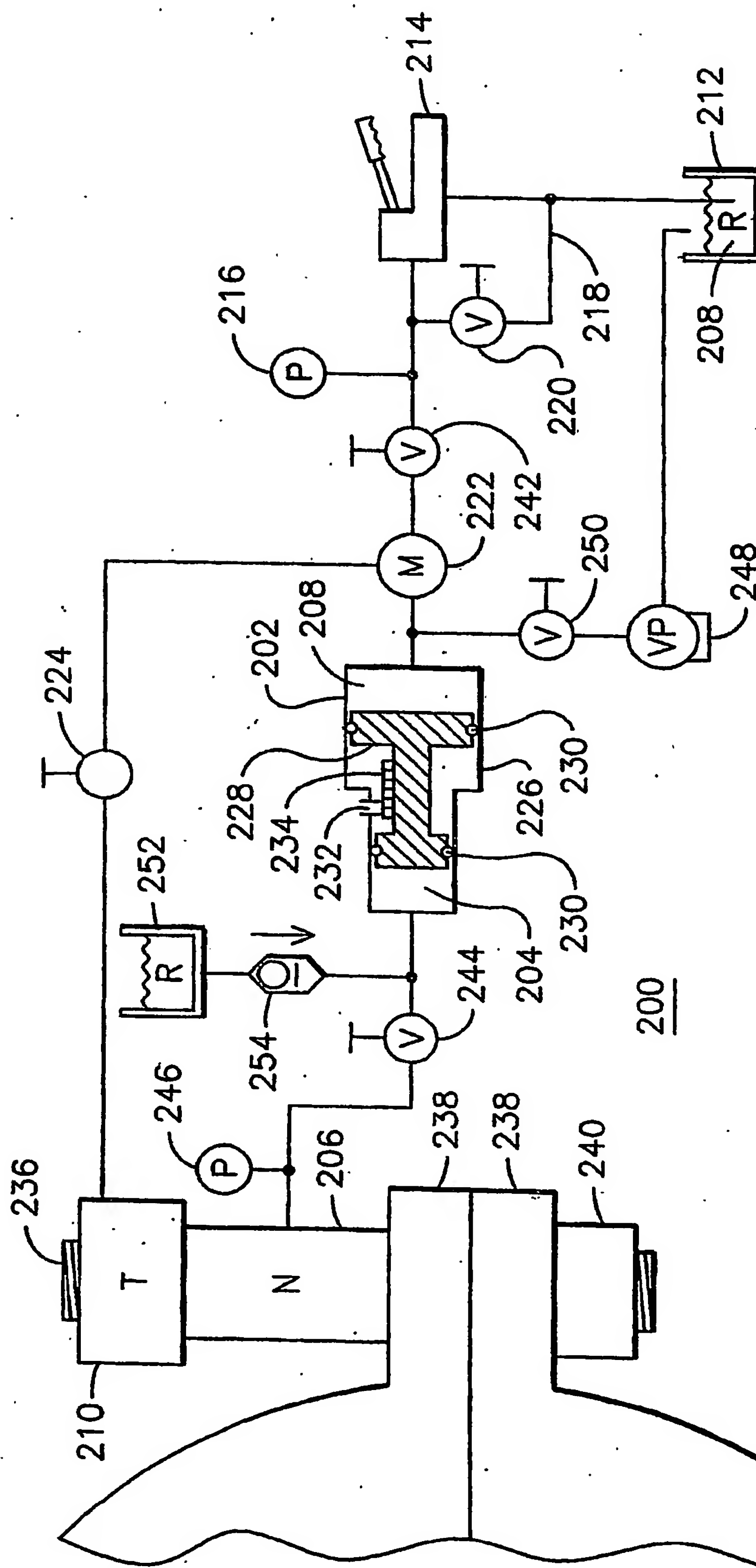
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REPLACEMENT SHEET

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## REPLACEMENT SHEET

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**FIG. 10**